Interim Progress Report submitted to NOAA HDGCR Program

Project Title: Pilot Studies to Evaluate Interpretation Methods, Intermediary Effectiveness, and Appropriate Levels of Intervention in the Provision of Climate Forecasts in the Sahel-Sudan: Climate Forecasting for Agricultural Resources (CFAR) Project-Phase 2

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I. Preliminary Materials

A. Project Abstract: The Sahel-Sudan region of Africa is one of the poorest areas of the world, whose economy depends mostly on rainfed crop and livestock agriculture. The region is an area that stands to benefit significantly from the appropriate application of climate forecast information to improve decisions affecting agricultural productivity and sustainability. Over the past decade, advances in climate models of international organizations have dramatically improved the skill of climate precipitation forecasts for broad regions of the Sahel-Sudan. The National Meteorological Services of individual countries have also developed forecasts for their specific agro-ecological zones. In 1997 Tufts University and the University of Georgia started the Climate Forecasting for Agricultural Resources (CFAR) Project, a multidisciplinary project with the goal of assessing how farmers (both agriculturists and pastoralists) in Burkina Faso can use climate forecasts to enhance agricultural sustainability and food security. We have described the complex of biological, physical, economic and sociocultural factors that farmers consider in devising potential response strategies to forecasts. We, like other researchers, have also found that the greatest challenge to achieving benefits from climate forecasts is communicating the right information to farmers at the right time so that farmers can correctly interpret the forecast and apply it in their decision-making.

This challenge is addressed in this new 3-year research project through pilot studies in Burkina Faso of farm-level application of climate forecasting. We seek to answer three major questions regarding the application of climate forecasts for improved livelihoods and sustainability of

agricultural systems in the Sahel-Sudan: 1) How can we best explain scientific information to farmers ? 2) What additional information or resources must accompany a forecast, and how should such information and resources be made available to farmers ? 3) What is the optimum role of intermediaries in forecast dissemination?

In order to answer these questions we have five **objectives**: 1) To develop methods that best explain and interpret forecasts for farmers; 2) To test different intervention strategies to assist farmers in developing improved methods to manage agricultural resources in response to climate forecasts; 3) To provide feedback to climate forecast and communication organizations on forecast needs; 4) To implement newly developed forecast products as appropriate for farm-level use; 5) To integrate and coordinate with other programs related to improving agriculture in the Sahel-Sudan.

B. Objectives: See above.

C. Approach: We continue to focus on farmers, including agriculturists and pastoralists, in the three main agro-ecological zones of Burkina Faso, which represent three distinct livelihood systems: 1) agro-pastoralism in the Sahel; 2) subsistence grain farming in the Central Plateau; and 3) commercial cotton production in the Southwest. In each zone we study three villages, with each of the three villages having a different level of forecast interpretation and intervention.

Level 1: Control. It is expected the only exposure to the forecast that farmers in the three Level 1 villages have is what may be disseminated through the mass communications media.

Level 2: Dissemination. Level 2 villages have farmers who attend a one-day forecast dissemination workshop. We request that these farmer-workshop participants disseminate the information to other village residents.

Level 3: Dissemination and Demonstration. Like those in Level 2, Level 3 villagers have access to farmers who attend a one-day forecast dissemination workshop, but also have access to intermediaries who attend the workshop. These intermediaries are selected from the normal extension services available in each of the three regions.

We document farmers' understanding and use of, and their responses to forecasts and related information during on-farm evaluations during the farming season as well as post-harvest.

D. Matching Funds: No matching funds were applied to this project.

II. Interactions

A. Decision- Makers and Collaborators: Our partners in Burkina Faso are the Direction de la Météorologie Nationale (DMN), the National Agricultural Research Service (INERA), and Plan International, a development NGO. The NMS develops the forecasts for the three main climatic zones of the country. They also participate in the workshops by presenting the forecasts to the farmers. INERA's role is to discuss the farming implications of the forecast at the workshops and, having been trained in crop modeling, to add the crop modeling component to the forecast interpretation and value. Plan International provides logistical support and communications with communities. As full research partners the DMN and INERA participate in all aspects of the project, including development of tools for research and communication, planning workshops and research activities, and assessing quality of data collected and functionality of instruments.

Collaborators from DMN and INERA conducted a quality assurance field trip to the three zones in September 2002.

Provincial-level government officials, representatives of technical services (Ministries of Agriculture, Livestock, Environment) and other stakeholders (development agencies, farmers' organizations, agribusiness, etc.) participated in the forecast dissemination workshops and are regularly kept informed of research activities and results by the CFAR team and facilitators. The USA Ambassador to Burkina Faso also attended the Boulsa workshop in June 2002 and addressed the participants, assuring them of the US government's full support for the project.

Dr. Christine Jost held an information exchange meeting with SOFITEX (the national cotton processing and exporting company) with the company's Agronomic Director and Communication Specialist at the company's headquarters in Bobo Dioulasso. SOFITEX has been an active participant in the PRESAO process. SOFITEX disseminates forecasts and agronomic advice to cotton farmers through its sponsorship of programs by private radio stations and through its field agents. They have been very interested in learning from the CFAR experience and have been regularly provided with research reports and findings.

Dr. Roncoli has facilitated communication between the Union Provinciale des Producteurs de Coton of Hounde and the USAID-funded RANET project managed by ACMAD. The Union is interested in purchasing radio broadcasting equipment from ACMAD and in establishing a RANET community-radio station in one of the main cotton growing areas in the country. The Union represents cotton farmers' interest in cotton transactions and participates in national level negotiations and policy-making, The radio will provide farmers with an alternative source of information to complement and counterbalance SOFITEX' forecast dissemination efforts.

Dr. Roncoli and DMN Director Dr. Ouattara met with the National Coordinator of Operation SAGA (a politically prominent, heavily funded cloud seeding project of the Government of Burkina Faso) to report on farmers' perceptions and concerns relative to the project and discuss how rainfall forecast could be integrated into the projects' intervention framework.

A the end of the post-harvest evaluation Drs. Christine Jost and Carla Roncoli, the CFAR facilitators, and INERA collaborators presented preliminary findings at a research seminar hosted by the INERA Research Station at Kaimboinse. The seminar was attended by INERA Director General and about 30 to 40 INERA scientists. Copies of the Power point presentation were shared with INERA and DMN.

B. Forecasting Community: We have been actively communicating with ACMAD and AGRHYMET by providing feedback on their programs and technical advice based on our research findings. They will be invited to the end-of-year workshop in 2005.

C. Coordination with Other NOAA HD Projects: We continue to formally and informally interact with many colleagues from the HD NOAA community by comparing data, sharing information, comparing survey instruments, and discussing findings. Several CFAR PIs have also served as formal or informal advisors for students of other OGP PIs (U. of Arizona, U. of California-Davis, U. of Florida) who are interested in working in West Africa. The NOAA HD Principal Investigator Meeting in October, 2002 greatly helped catalyze these interactions. We also co-organized (with Mamadou Baro of the U. of Arizona) a panel on Coping with Climate Variability, including a number of HD PIs, at the 2002 Annual meetings of the African Studies Association. CFAR PIs have served as proposal reviewers for other OGP programs.

III. Accomplishments.

A. Research Tasks Completed: Research activities begun with meetings with project partners (DMN, INERA, Plan International) to fine tune research approach and instruments, and confirm roles and responsibilities. We also identified the Level 1 villages in the three zones (Level 2 and 3 villages were those that participated in CFAR Phase 1, except in the Sahel, where a Level 2 village had to be replaced with a new village due to a law enforcement investigation that created a climate unfavorable to community participation in the project).

Forecast dissemination:
Provincial workshops were then held in the provincial capitals of the three zones, respectively Houndé (June 19-21), Boulsa (June 25-27), and Dori (July 1-3). The ACMAD forecast was obtained on June 17, when DMN collaborators returned from Niamey. The rainy season had already begun in two of the sites (Southwest, Sahel), but farmers had not finished planting. The onset of the rains had not yet occurred in the Central Plateau, and farmers were fearing a drought; the forecast (which predicted average-to-above average rainfall) encouraged them to continue planting. This resulted in a considerable benefit to farmers because, once the rains started, they unfolded favorably, leading to a good performance of most crops.

Workshops in each town unfolded over 3 days, including a) first day: training for potential intermediaries (extension and development workers active in the Level 3 villages); b) second day: official opening by provincial authorities, presentation of the forecast to farmers in Levels 2 and 3 by DMN, comparison to indigenous forecasts, discussion of potential response strategies with farmers facilitated by INERA; c) third day: discussion of dissemination and communication strategies with farmer with Levels 2 and 3, final recapitulation and planning session with intermediaries in Level 3. Participants included male and female farmers and herders from Level 2 and Level 3 villages (14 farmers per village). Local language translation was provided in Djoula, Mooré, and Fulfulde.

Data collection:
In June 2003, raingages and thermometers were installed in selected fields of participating farmers by teams composed of CFAR, DMN, and farmers. In total, 54 raingages (6 raingages in each of 3 villages in each of the 3 zones) and nine thermometers were installed and farmers trained to read them A total of 216 microplots (4 in each field that hosts a raingage) were also established for observation of farmers response strategies and yield outcomes. 9 soil samples in the villages were also collected at this time and later analyzed by INERA.

During the remainder of the rainy season, the CFAR facilitators collected the rainfall and temperature data from contact farmers every two weeks and sent copies to the DMN, INERA and CFAR. They also conducted 3 rounds of socioeconomic surveys, including a baseline survey (end July), an intermediate survey (Aug-Sept) and a final survey (Nov). In Level 2 and 3 villages the sample included 11 farmers who participated in the workshop (including the 6 raingage holders) and 10 farmers who did not (N=21). In Level 1 villages (which did not participate in the workshop) the samples included 6 raingage holders and 10 other farmers (N=16). Participants in the survey were identified by the CFAR facilitators in collaboration with extension workers, community leaders, and lead farmers according to a purposive sampling strategy that aimed at representing various ethnic groups, village sections, livelihood portfolios and taking into account availability. The surveys focused on production practices (including crop and livestock management), farmers' access and understanding of forecasts, and expected outcomes of production decisions and aimed at tracking the unfolding of decision making throughout the season.

A mid-season evaluation visit was conducted in September 2003 by the DMN and INERA collaborators who visited Levels 2 and 3 villages in the three zones to discuss with farmers how the season was going compared to what had been forecasted at the workshop, what adjustments they had made to their original response plan, and what their preliminary evaluation of the utility of the forecast was as well as to check on the state of the equipment and control data quality. Level 1 villages were also visited to check on equipment and quality control.

A post-season evaluation was conducted during February and March 2003 by Drs. Christine Jost, Keith Ingram and Carla Roncoli, in collaboration with CFAR facilitators (DMN and INERA key collaborators were abroad for training). The evaluation hinged on semi-structured interviews with all farmers included in the socioeconomic sample (respectively 21 in Level 2 and 3 villages, and 16 in Level 1 villages). The questionnaires elicited information on farmers' expectations and perceptions of the season, farmers' access and understanding of the forecast, farmers' evaluation of the forecast, farmers' interaction with intermediaries, farmers' own roles in dissemination, farmers' adaptive responses (and constraints upon them); and production and livelihood impacts. Background information for Level 1 villages (which were not the object of research during CFAR's first phase) was also gathered in the course of focus groups with farmers, herders, and women by using PRA techniques. Data were collected on socio-demographic profiles, agro-ecological context, infrastructure and communication networks, crop and livestock management, adaptive strategies, perceptions of climate change, and local forecasting knowledge. Research instruments are in Appendix A.

Capacity building and crop model development:
Agricultural scientist Moussa Sanon of INERA begun crop modeling training at University of Georgia under the direction of Dr. Hoogemboom on February 1st 2003 and is returning to Burkina Faso on May 31, 2003. Dr Sanon used data from the raingages, microplots, soil samples, and socioeconomic surveys to adjust the DSSAT crop model for the major staple cereals produced in the three zones (maize, millet, sorghum). Further data collection will be needed to fully calibrate and verify the model for the regions. Attached to this report is a diagram of a decision-support system based upon the crop modeling and the forecast prepared by Dr. Sanon.

B. Summary of Preliminary Findings: The key research questions mentioned above were addressed inductively, by exploring three domains of investigation: a) how various aspects of the forecast were understood by farmers and what factors shaped these understandings (which addresses the question of how to present forecasts to farmers); b) how the information was (or was not) disseminated by various agents and channels, and what factors enabled or hindered this dissemination (which addresses the question about intermediaries); and c) how the information was applied in making production decisions (which addresses the question about what additional information and interventions should complement forecasts). Since the data are still being analyzed we are unable to quantify our findings or to enunciate conclusive answers to the research questions at this stage.

a) Understanding of the forecast

- *Seasonal rainfall quantity.* Despite efforts at workshop to avoid qualifying predicted seasonal rainfall in terms of 'good or bad', many farmers translated the forecast into the amount of the rains and some translated it to estimate the quality of the remainder of the farming season; farmers are primarily interested in information on the quality of the farming season rather than absolute rainfall parameters. This affects what farmers understand and retain. Most farmers who obtained the forecast (which was for higher probability in mid and high terciles)

translated it in terms of 'it will rain, it will rain well/a lot, there will be much rain/water, many rains, big rains, abundant rainfall'. Some farmers went further and understood that there would be "enough rain for the crops."

- *July-Aug-Sept.* Much effort during the workshop was directed to better explain the temporal scope of the forecast to avoid repeating the experience of 2000 when many farmers understood the notion that the forecast for the months of July, August, and September was a prediction that the rainy season would last 3 months. Many farmers correctly understood that the forecast pertained to the 3 months following the workshop (which was held in June), although not all farmers remembered the names of the months. Many farmers understood well that the Met Service cannot predict the onset and the end of the season (or rainfall during the months of June and October). But some farmers moved from their understanding that the season would be 'good" to the conclusion that the 'rains will last to the end' ('end' being defined not as a fixed date but in terms of what rain crops needed to come to full maturation).

- *Probability.* Another key question that informed communication efforts at the workshop was how to convey the probabilistic aspect and the probability distribution of the forecast. Several teaching tools (spinning wheels, colored squares, drawings) were prepared and presented to intermediaries and farmers. But in a less directed situation, both intermediaries and farmers spontaneously leaned toward verbal, rather than visual, explanations, such as metaphors that drew from daily life. Qualitative assessments were more salient than quantitative estimates of probability. Post-harvest evaluations indicated that the accuracy of forecast was often assessed in terms of spatial and temporal variability, with the forecast package being decomposed and evaluated piece by piece rather than as a whole. By and large farmers understood probability in terms of uncertainty, i.e. the Met Service can predict it will rain over certain zones and during certain months but not exactly where or during which month. Some farmers correctly retained that the forecast was valid for their zone, and not for others, but a few incorrectly translated this concept into spatial variability as it would rain in some areas but not in others. A few farmers reported understanding that 'there was a big chance…' or 'it could be that.' or 'if God wills' rather than a more deterministic interpretation. But several farmers assumed certainty because the information was brought by urban-based educated persons and foreigners who traveled long distances to do so. Farmers also cited the written format of the information (our notes), the planning work required by the workshop, the technology involved in forecasting, and, generally, the effort expended in 'searching' as a basis for expecting the information to be accurate.

- *Agronomic advice.* Farmers' own experience with adaptation to climate variability and their interaction with outside conservation efforts shaped the retention of complementary information. In most cases, farmers remembered forecasts in connection with various pieces of technical advice that were discussed at the workshop or during the community meetings organized by workshop participants to inform their fellow villagers. In particular, farmers retained advice on soil and water management, choice of crop varieties, and input application. Mostly these recommendations were a) practices that farmers were already familiar with and implement to respond to different rainfall scenarios, and b) techniques commonly promoted by extension or development projects.

- *Other interventions.* In some cases farmers who did not attend the workshop confused the seasonal forecast with daily weather forecasts or reports heard on the radio that provide information relative to various towns. In some cases this resulted in a more localized interpretation of the forecast. Farmers in the Southwest also believed the forecast dissemination effort was connected with Operation SAGA. Some understood that the

government had received foreign aid to make rain by using airplanes and, therefore, drought spells would be less likely. This suggests that is important to anticipate these potential misunderstandings and clarify the relationship between different sources of climate information.

b) Dissemination of the forecast

- *Workshops.* Many farmers found the workshops to be an effective way of disseminating forecasts, although they would have liked them to have happened earlier in the season (mid May at the latest). This was especially the case in the Southwest where farmers begin planning for the season in April and begin planting cotton in late May. Some farmers would have preferred more time to assimilate the information but others felt that two days were the most time they could afford to be away from their fields. In most cases, except in the Southwest where more farmers are Francophone and listen to weather broadcasts, farmers did not understand who produced the information. The close relationship between source and credibility of the information warrants a greater effort to explain the involvement of national and international institutions involved in its production, dissemination, and evaluation (we had incorrectly assumed that farmers, unlike technical services and government officials, would not be concerned with these institutional aspects). Most women preferred a mixed workshop rather than separate workshops for men and women, because they felt the former provide them with greater opportunities to learn. But they liked breaking up into small groups for the Q&A session.

- *Village information networks.* The workshop model was predicated upon farmer-to-farmer communication. Our previous research has indicated that farmer-to-farmer exchanges are salient mechanisms through which most information or technology transfer occurs. Workshop participants had committed to share the forecast with their own families and communities. In most cases, restitution meetings were organized either at the village or village section (*quartier*) level. Participants also talked informally at mosques, markets, and meeting places (*forge*), which are also important outreach nodes. But some obstacles and drawbacks in village dissemination efforts were identified. Some participants downplayed the probability aspect of the forecast to reinforce their own credibility (some were later challenged by fellow villages when the forecast was perceived to be 'wrong'). Several participants wished to have had more information on how the forecast was produced (a question that was often posed during the village meetings). Social norms for appropriate social interaction occasionally hindered outreach; in some cases youth could not ask questions to elders, but elders also complained that youth were unwilling to share information with them. Village center meetings were not easily accessed by residents of marginal village sections (when village sections belong to different political factions, the very location of the meeting became a bitterly contested issue).

- *Key farmers.* In Level 3 villages, many farmers pointed to the potential role of 'lead farmers', prominent villagers that can provide a link between forecasts producers/providers and their communities. In fact, some of our key informants, who had participated in previous CFAR research activities and in the 2000 PRESAO Forum, provided leadership in forecast dissemination and support to other farmers in forecast interpretation. Farmers emphasized trustworthiness and generosity, as well as farming experience and ability to deal with outsiders, as essential attributes for effective 'lead farmers'.

- *Extension and development agents.* The original research design intended to assess impact of trained intermediaries (extension or development agents) but very few farmers reported

any contact with them. Some of the trained agents were later transferred elsewhere, and generally agents had very little resources and motivation to travel to villages and work with farmers. However, when asked about potential communication avenues, farmers did refer to agents from the agriculture and livestock ministries and other development agencies (more often so when a foreign funded project enabled the agent to be active in the community). Farmers in the Southwest had mixed opinions about the potential role of SOFITEX agents, who are frequent in the village but who also tend to be young, have a high turnover, and whose primary mandate is the commercialization of cotton rather than technical support.

- *Local leaders*. Inevitably, chiefs and/or *delegués* (government representatives at village levels) had to be involved in the selection of workshop and survey participants and were sometimes mentioned during interviews as potential avenues of dissemination. Some farmers also mentioned Islamic leaders (*marabouts*). However, despite efforts to ensure representativeness of all social groups, there was evidence that local politics and personal agendas affected inclusion or exclusion of social groups. In some cases, Peul pastoralists living on the margins of village territory were neither included nor informed. In others participation was predicated upon loyalty to the village leader.

- *Farmers organizations*. Participants shared information with members of groups they belonged to (GPCs, herders' associations, women's group). Many farmers in the Southwest pointed to the key role of the *Groupement Producteurs de Coton* (farmers cooperatives set up by SOFITEX for credit and input distribution). GPSs have frequent meetings and are led by literate members. They are a viable framework for information dissemination in cotton producing areas, but agropastoralists and farmers who are too poor to grow cotton do not belong. Likewise, herders' association may be based on lineage, place of origin, and time of settlement and do not include all Peul pastoralists that live in the area.

- *Radio.* The radio is a way of broadening access to information and conveying information in timely manner and plays a key role in several pilot projects (i.e. RANET Project). But the main limitations are: a) farmers cannot ask questions or repeat the information; b) radio broadcasts are often too cursory to convey complex notions such as probability forecasts; c) one does not always know the time when important information is broadcasted; d) one does not always know who or where the information comes from; e) in May-June farmers are often too busy to listen to radio as they work on fields far from villages; and f) not everyone has radios, especially among pastoralists and women. Local FM stations are popular because news is locally relevant and broadcasted in the local variety of the vernacular language. In some villages, there are periods during the year when the national radio cannot be received. Only a few wealthy farmers have TVs.

- *Written media and materials.* Literacy levels are very low (except in the Southwest where farmers benefited from rural literacy program). Newspapers do not circulate widely and generally are not relied upon for information. But farmers indicated that they would like to have the forecast explained in a printed pamphlet in local language (that can be read by literate youth) to help them remember the information or discuss it with others.

c) Application of the forecast

- *Land management.* Most common responses were in line with technical advice discussed-received at the workshop or during restitution. But farmers adapted to their own specific

conditions. At the time of forecast dissemination, farmers in the Southwest had already started tilling fields, but after receiving a forecast for higher-than-average rainfall some farmers shifted orientation from parallel to perpendicular the slope to slow down water flow and retain nutrients. Some farmers added stone barriers across fields to prevent runoff and erosion or to reclaim less fertile areas. In all sites, farmers mentioned that a forecast for 'good rainfall' encouraged them to keep working in their fields at a time when the onset of the rains was late and they were losing hope and abandoning their fields. However, farmers would also appreciate receiving the forecast even if it was for the lower tercile because they would be able to save effort, inputs, and seed.

- *Planted acreages.* In all sites farmers responded to forecast by increasing area planted, generally between _ to _ of a field. This was achieved by continuing to plant until a later date; bringing back clayey or elevated parts of fields that had been abandoned; clearing new areas adjacent to fields and planting them with sorghum (which does better than maize on those fields). Farmers in the Southwest who wanted to expand planted area to take advantage of good rains planted maize since the optimal planting date for cotton had already passed. Farmers in the Sahel and in the Central Plateau also brought back old fields or cleared new fields. In some cases, in the Central Plateau farmers practiced *zai* and *cordons pierreux* to recuperate infertile portions of land. A few farmers in the more humid Southwest abandoned valley bottoms or lower parts of fields for fear of flood (but later regretted this decision because rainfall was less than expected).

- *Crop choice.* Farmers responded to the prediction for abundant rainfall by planting rice rather than maize or sorghum in lower areas, or substituting cotton (which better withstands humid conditions) where they had planned to plant maize. In all sites, farmers responded to the forecast by planting more secondary crops: groundnuts, Bambara nuts, beans, and sesame. Women added okra and sorrel as well as expanded millet and sorghum fields. In some cases farmers invested in purchasing more seed. Results varied according to planting date, toposequence, and soil type (lowland vs. upland fields).

- *Crop varieties.* Farmers responded to forecast by changing crop varieties. In some cases, they switched to more productive longer-cycle varieties for sorghum or maize, or they chose to continue planting those rather than switching to shorter-cycle varieties as they had originally planned to do. In other cases, farmers switched to shorter-cycle (50-60 days) varieties to be able to continue planting in late July and early August, betting on the probability of having rain until the end of September (as they understood that forecast predicted rains for July, August, and September). Except in the Southwest, where farmers plant improved maize varieties, all crop varieties adopted were of local origins.

- *Input application.* A few cotton farmers increased fertilizer application, in order to take advantage of the predicted good rains, incurring additional debt to purchase it. But since the rains ended prematurely, the outcome was poor and did not make up for the additional cost.

- *Livestock management*. In the more humid Southwest, farmers moved animals to higher ground and increased treatment for animals in response for a forecast for higher-than-average rainfall. In the Sahel, some farmers responded by calling back animals from distant pastures (in the expectation for sufficient local availability of pasture) or decided to keep animals around the village rather than send in transhumance.

- *No response.* There were some cases of 'no-use' of forecast information. In some cases it was because dissemination occurred too late (farmers had already finished planting all their

available land by the time of the workshop). In other cases, resource constraints, especially labor, suitable land, farm equipment, and short duration varieties constrained farmers' decisions.

- *Updated forecast.* Most farmers are interested in a forecast update (only a few were not, mentioning potential for confusion, reduced credibility, low utility of late information). In the Central Plateau and in the Sahel, farmers finish planting by early August, but can still use an update to decide how to distribute their labor between lowland or upland fields, weeding more intensively those that have more chance of success. In the Southwest farmers can continue planting until late August (even September for sesame). But if the updated forecast predicts drier season, they can quit planting, saving labor and seed; they can return unutilized fertilizer and inputs and devote their energies and resources to non-farm work to make up for the production shortfall

C. Papers and Presentations during this Period:

Roncoli, C., K. Ingram., P. Kirshen, and C. Jost. Scientific Discourse and Social Meanings in the Dissemination of Seasonal Rainfall Forecasts in the Sudan-Sahel Region of West Africa. Paper presented at the Conference on the Human Dimensions of Global Environmental Change, Berlin, Germany, December 6-7, 2002.

Roncoli, C., K. Ingram., P. Kirshen, and C. Jost. Packaging Predictions: Experiences in the Communication of Climate Information to Farmers of Burkina Faso. Paper presented at the Annual Meetings of the African Studies Association, Washington, DC, December 5-9, 2002.

Roncoli, C., K. Ingram, P. Kirshen, and C. Jost. 2002. Farmers' Behavioral Responses to Seasonal Rainfall Forecasts in the Sudan-Sahel Region of West Africa. Paper presented at the 17th Symposium of the International Farming Systems Association, Orlando, Florida, November 17-20, 2002.

Roncoli, C., K. Ingram., P. Kirshen, C. Jost, and G. Hoogemboom. 2002. Salience and Meaning in Knowledge Encounters: Anthropological Perspectives on Eliciting Users' Needs. Paper presented at the NOAA Office for Global Programs Principal Investigators' meeting, Seabrook Island, SC, October 22-25, 2002.

Kirshen, P.H., Value of Short Term Coping Strategies for Adapting to Long Term Climate Change, Paper presented at Human Dimensions of Global Change Principal Investigator Meeting, Seabrook Island SC, October 23-25, 2002.

Roncoli, C. and T. Finan. Livelihood Vulnerability, Climate Applications, and Public Policy: Anthropological Contributions to a Conceptual Framework. Paper presented at a Conference on Environment, Sustainability, and Public Policy, Athens, Georgia, September 7-8, 2002.

D. Significant Deviations from Workplan: While significant accomplishments have been obtained, we made several adjustments to the proposed action plan to respond to collaborators' requests, changing field conditions, lessons learned, and procedural challenges.

1) Radio broadcasting plays a lesser role than originally anticipated because Burkina Faso has not yet elaborated an official national policy of forecast dissemination. The DMN considers the forecast to be too experimental to allow its broadcasting on national media. However SOFITEX

broadcasted the forecast through private radio stations in the cotton zones, and local stations in the CFAR sites also reported on the workshops. Our socioeconomic surveys and post-harvest evaluation captured the impact of these programs and of other climate-rated broadcasts.

2) Support by extension and development agents was a key element in the original research design. However, during our field activities and interactions with farmers we realized that the potential role they could play was limited by several factors including: a) lack of resources available to government extension services (we decided against providing additional resources to provide services in the CFAR villages because the solution would not be sustainable); b) high staff turnover (extension agents that were trained during the 2002 workshop were shortly thereafter assigned to other zones); and c) language problems (because of regional imbalances in educational opportunities, some extension and development workers, especially in the Sahel, belong to different ethnic groups than farmers in the villages they serve and do not speak the local language). Due to these factors, government extension workers are not always an active and trusted presence among farmers. NGO workers are better equipped and more frequent in the villages but their scope of intervention and agricultural technical knowledge is often limited. On the other hand, we found that farmers tend to rely far more on other farmers than on extension workers for information and technological innovations. We therefore shifted our focus from extension workers to 'lead farmers' as the key intermediaries envisioned by our research design. These lead farmers are Level 3 villagers who are influential in the community by virtue of their social position and farming knowledge and who have participated in CFAR research activities and in the PRESAO Forum in 2000 (and therefore have a greater understanding of the forecast parameters and limitations than other villagers). Some of them are among the 6 farmers in each village who hold and read the raingages.

3) We originally intended to have three villages in each zones representing different levels and types of forecast-related information and support. In order to do this we selected two villages (representing Level 2 and 3) in each site which had participated in CFAR activities during the project first phase, and added a third village (representing Level 1) where we had not worked before. This village was not involved in the workshop but are involved in other research activities (raingages, surveys, mid-season visit, post-harvest evaluation) though which information about the forecast filtered through, generating much interest among farmers. Consequently, after discussion with CFAR research facilitators and community leaders, we concluded that it would be socially and ethically problematic to exclude the village from participating in the 2003 workshops. Although this represents an unbudgeted expense, we will include 10 farmers from Level 1 villages in the 2003 workshops. We will also establish a Level 0 village in each site to serve as baseline. No research activities or visits will be carried out in Level 0 villages until the post-harvest evaluation.

4) The 2003 forecast dissemination workshop will be held at the village level (in Level 3 villages) rather than in the provincial capital of each region. This will enable a more participatory format, integrating field visits, hands-on exercises, and farmer-to-farmer exchanges as well as greater involvement by community and religious leaders. Farmers will be more at ease in interacting with DMN and INERA scientists in their own area in a less formal environment. Extension and development agents who operate in Level 1-2-3 villages and the provincial representatives of Ministries of Agriculture, Livestock, and Environment will also be invited. Simple graphic handouts written in local languages will also be prepared and distributed to workshop participants.

4) The delay in releasing the funds from NOAA to Tufts meant that we begun field activities later than planned (after the onset of the rains). Therefore, we were unable to collect a full season of

rainfall, agronomic, and socioeconomic data. Moreover, the delay meant that we were unable to bring the visiting scientist to the University of Georgia in Fall 2002 to work on crop modeling as originally planned. As funds became available in October we were only able to complete visa and travel procedures to bring the scientist to the University of Georgia on January 31st. Because of the incomplete data set and delay in training, we will not be able to integrate crop modeling results with the seasonal rainfall forecast before the onset of the 2003 season. We will be able to do so by the end of the 2003 growing season (which will provide us with a full season of data) but not in time to evaluate farmers' responses to the crop modeling results. However, crop modeling results will be presented and discussed with other researchers, and non-farmer stakeholders in the planned 2005 end-of-project workshop.

IV. Relevance to Field of Human-Environment Interactions.

A. Use of Climate Data in Decision-Making: Through understanding farmer's behavior in response to the forecast and related information, we are seeking to improve the utility and effectiveness of climate data. During CFAR Phase 1 we documented farmers' climate information needs in terms of parameters, timing, and source. In this second Phase, in the course of the provincial workshops, we are experimenting with different representational forms and communication tools to convey notions of probability and forecasts limitations. In the course of the socioeconomic surveys and in-depth interviews we are analyzing the process of decision-making. However, we do recognize that farmers' decisions are very complex and entail consideration of many different factors, including but not limited to forecasts. In some cases decisions are based on farmers' performative knowledge, which may not be explicitly articulated but it is based on a combination of past experience, assessment of present environmental conditions, perception of available options, and household risk tolerance.

B. Building on Previous Research: This project directly builds upon the first phase of the CFAR research project (1997-2001) that examined opportunities and obstacles to forecast use in Sahel-Soudan information networks in the three zones of Burkina Faso. The project also capitalizes on the institutional relationships established by the USAID-funded Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program in Burkina Faso (1994-1997). Our work also builds upon and contributes to the knowledge generated by NOAA and other HD-funded research projects on similar topics in other regions.

C. Contribution to Other Areas:
1. Adaptation to Long-Term Climate Change. Our research seeks to understand how forecasts are used to respond to interannual climate variability. However, the repertoire of adaptive responses enacted by farmers and herders includes technologies and strategies that have been adopted to cope with perceived longer term climate fluctuations (i.e. adoption of shorter cycle varieties from northern, drier regions of the country). An understanding of the dynamics of diffusion and adoption of such adaptations will contribute to the formulation of policies and approaches that support farmers' adaptive capacity.

2. Natural Hazards Mitigation. The extended timeframe of our research in Burkina Faso has enabled us to witness the impact of and response to climate extremes, such as flooding in the Southwest in 1999 and severe droughts in the Central Plateau in 1997 and 2000. Through household level surveys and intensive interviews we were able to document how differently-endowed households were affected and how differently-positioned social actors (men, women, farmers, herders) responded. We were also able to highlight the trade-offs and compromises entailed in adaptation and to formulate recommendation for policies that promote long-term sustainable development over short-term survival.

3. Institutional Dimensions. CFAR Phase 1 begun with an institutional analysis of the potential for use of forecasts in planning, resource allocation, development assistance, relief interventions, etc (published in Natural Resources Forum, Aug 2000). Many of those findings are still valid although we have continued updating our understanding throughout the research process. We are documenting shifts in institutional policy and practice that affect farmers' access to resources and information that they need in order to optimally use forecasts. These include changes in SOFITEX credit and input provision policies, the onset or end of development projects, the creation of new farmer organizations, and the redefinition of administrative boundaries (which determine villagers' access to NGO resources and government services).

4. Economic Value of Forecasts. Assessing economic impacts of the forecast is hindered by the fact that farmers in at least two of the zones (the more commercialized Southwest being the exception) do not measure acreages, yields, and inputs (seed, manure, etc) precisely. Most factors of productions in all three zones (land, labor, and inputs) are not commoditized, and crop and animal prices vary seasonally. However, by using proxies and relative values we arrived at an estimate of gain or losses for farmers that reported changes in production practices due to the forecast.

5. Decision Tools. The crop modeling component will provide a key decision support tool. Modeling results will be presented and packaged in different ways to enable farmers as well as other stakeholders to use the information to make decisions.

6. Sustainability. All forecast dissemination approaches and application strategies that we are testing are sustainable in the long run given the level of resources available to the institutions, stakeholders, and farmers involved. Therefore we have avoided solutions that cannot be sustained (i.e. paying extension workers to act as intermediaries in Level 3 villages). Participation in the project is increasing research and technical capacity of collaborating institutions and stimulating greater interaction among various institutions (meteorological services, agricultural research, development NGO, and extension services of ministries). The project has been successful in promoting a user-relevant, demand-driven research agenda and participatory methodologies that enable scientists to learn from farmers.

7. Scientific/ Local Knowledge. Farmers use a repertoire of forecasting techniques to formulate expectations relative to the rainy season. Generally they do not rely on any of them in making decisions on crop and livestock management until they are verified against what is considered the most reliable indicator, namely the timing and nature of the onset of the rains. Farmers consider their own forecasting techniques to have become less reliable because of perceived greater climate variability during the last 30 years. Therefore they are open and interested in receiving scientific forecasts. Combining indigenous and exogenous knowledge systems is not new to farmers who are used to rely on both local and scientific solutions in agriculture, health, etc. Customary leaders and Islamic imams are not opposed to introduction of scientific forecasts and are willing to collaborate with dissemination efforts as long as the information is presented in ways that respects their beliefs and their prerogatives.

8. Public Policy. Burkina Faso does not have an official national policy of forecast dissemination. The decision is a political rather than technical one, resting with the Council of Ministers. The perception of the forecast as still 'experimental', the potential political liabilities from the possibility that the forecast may 'fail' and result in economic losses and popular discontent, and the competition from other politically-prominent programs (i.e. Operation SAGA) may also shape forecast dissemination policy. On the other hand, semi-private powerful

agribusinesses, such as SOFITEX, are able to obtain and disseminate the forecast through private means regardless of official policy.

9. Socio-Economic Impacts of Decadal Climate Variability Farmers in the three zones perceive that a change in climate has occurred since the 1970s in terms of decreased rainfall, shortened rainy season and erratic rainfall patterns (farmers lament that 'the rains have become like the national lottery'). Adaptive strategies adopted by farmers and herders have resulted in exacerbating tensions between the two groups (i.e. farmers have responded by expanding planted areas in lowlands that provided much needed pasture during the late dry season, herders have diversified into agriculture and compete with farmers for land). The expansion of acreages to compensate for lower productivity also produces greater competition for land between original residents and immigrant farmers and herders in the Southwest.

10. Other. Despite much effort in ensuring equity and inclusivity in all aspects of the project, we could not entirely prevent local social cleavages to shape participation in the workshops and research activities. Knowledge is power, especially when associated with access to (even modest) resources and contacts with outsiders. Some level of marginalization along social and political lines did occur. The imbalance generally favored agriculturalists over pastoralists, even when the latter belonged to a higher caste. In some cases Peul herders were not able to participate in the workshop and did not receive the forecast during village level dissemination. 'Noble' Peul herders were also left out when government appointed village leaders belonged to the formerly-enslaved (but now politically prominent) Rimaibe caste. Local political disputes and/or competition for land were also played out in selection of contact farmers and workshop participants. We are incorporating these learnings in planning for the second year activities as well as preparing to analyze those issues in a paper to be submitted to a pastoralism-focused journal.

V. Graphics.

We will be supplying copies of Power Point presentations and photos of fieldwork on CD. Attached is also figure of crop modeling and forecast based decision support system for farmers.

VI. We have no website.

Appendix A

Feb-March 2003 Protocols

Interview Protocol Feb-Marhc 2003
PROGRAMME DE TRAVAIL SUR LE TERRAIN
VILLAGE 2 ET 3

1.1 Avant l'installation de la campagne, qu'est-ce que le producteur s'attandait en matière de pluviométrie? Sur quelle base avait-il formé cettes attentes?

a. Pendant les mois qui precedent l'installation de la campagne, est-ce que le producteur avait observé ou entendu des signes ou des choses indiquant comment la campagne va se passer? Quel signe et à quel moment s'est-il manifesté?
b. Comment la campagne s'est-elle passée? Si le producteur dit 'bonne' ou 'mauvaise', expliquez exactement qu'est que ç'a était 'bon' ou 'mauvais' (i.e. l'installation, des poches de sechéresse, la fin, etc.).
c. Par rapport à ce qu'il attendait, comment la campagne s'est deroulée? (comparer leurs prévisions et la realité). Est-ce qu'il pense que les prévisions locales se sont verifiées? Lesquelles et dans quelle mésure?

1.2 Est-ce que le producteur a reçu la prévision météo?
a. Par quelle source (radio, journal, atelier, voisin, animateur)?
b. Qu'est-ce qu'il a compris? Qu'est-ce qu'il a trouvé facile à comprendre, qu'est-ce qu'il a trouvé difficile?
c. Comparer la prévision météo et la réalité (comment la campagne s'est en fait deroulée). Est-ce qu'il pense que la prévision météo se sont verifiées?

1.3 Répondre aux questions suivantes par rapport aux différentes sources d'information par lesquelles la prévision a été diffusée (radio, journal, atelier, voisin, animateur) :

a. Quelle source est plus accessible au producteur? Par laquelle peut-on mieux arriver à les toucher?
b. Quelle source est la plus efficace à les faire bien comprendre la prévision?
c. A quelle source ont-ils plus de confiance?
d. Comment peut-on améliorer l'efficacité et la fiabilité de chaque source?

2.1 Est-ce que quelcun a discuté la prevision météo avec lui? Qui et pourquoi?
a. De quoi ont-ils discuté?
b. Dans le cadre de la discussion, qu'est-ce qu'il a aidé à mieux comprendre la prévision? Qu'est-ce qu'il a permi de mieux utiliser la prévision?
c. Qu'est ce qu'il aurait été plus efficace?
d. Cette conversation, à quoi a-t-elle abouti, qu'est-ce qu'a été le résultat ?

2.2 Si le producteur a reçu la prévision météo, est-ce qu'il la discutée avec des autres producteurs ?

a. Avec qui et à quel fin (i.e. chercher des clarifications, donner des conseils, etc.)
b. De quoi ont-ils parlé? Qu'est-ce que ont-ils dit ?
c. Qu'est-ce que était facile à expliquer, qu'est-ce que était difficile?
d. Qu-est-ce qu'on pourrait les aider à mieux expliquer les prévisions aux autres?

a. Comment que les autres ont réagi ? Qu-est-ce qu-ont-ils repondu?
b. Cette conversation, à quoi a-t-elle abouti, qu'est-ce qu'a été le résultat ?

2.3 Est-ce que le producteur avait des questions rélatives aux prévisions météo pour lesquelles il n'a pas eu des réponses satisfaisantes?

a. Quelles autres informations faut-t-il lui donner pour rendre la prévision météo plus utile?
    - Est-ce qu'il voudriait la recevoir/entendre plus souvant/plusieurs des fois ?
    - Est-ce qu'il voudriait recevoir des mises à jour? Comment pourriait-il les utiliser ?

b. Comment faudrait-il lui faire parvenir la prévision? Qui est-t-il mieux placé / indiqué pour lui donner la prévision?
c. Quelles autres ressources auriait-il besoin pour mieux utiliser la prévision météo?

3.2 Est-ce que il a pris en considération la prévision météo dans le cadre de ses stratégies de production agricole et animale, dans la gestion des ressources et des stocks, etc. ?

a. Si non, pourquoi non?
b. Si oui, quels changements a-il mené, et pourquoi ?

Par rapport à vos programme préliminaire de culture, qu-est-ce que vous aviez decider de faire à l'installation de la campagne (voire ci-dessous) ? Est-ce que vous avez apporté des changements à cause de la prévision ?

Choix des cultures, choix des varietés
Quantité (superficie) de chaque culture
Où semer quoi (toposéquence, type de sol)
Si elargir ou réduire les supérficies cultivées dans chaque champ
Comment diriger leurs efforts (entre différents champs, cultures, tâches)
Préparation du sol/champ pour les semis (labour)
Pratiques des conservation des eau et de sol (i.e. zai, paillage, diguettes)
Quand semer les différents cultures
Dosage et application de fumier, engrais (combien, quand, où)
Autres intrants chimiques (pesticide, herbicide)
Si prendre des crédits, dans quelle mésure
Vente de produits agricols, animals
Si partir en transhumance, quels membres de la famille, quand, vers où, etc.
Si vacciner les animaux
Gestion des stocks

3.3 Si le producteur dit qu'il a pris en considération la prévision dans ses stratégies, est-ce que il y a eu des autres evénements ou raisons qui ont influencé cettes decisions (i.e. comportement d'un voisin, changement dans le milieu economique ou environnemental?).

c. Comment qu'on est arrivé à cette decision?
d. Qui était impliqué dans cette decision? Est-ce qu'il y avait des opinions contrastantes entre les decideurs? Laquelle a été retenue finalement ?
e. Qui est responsable pour l'issue de cette decision ?

3.4 Quels impacts chaque decision prise à la base de la prévision a eu sur les aspects suivants de production agricole et animale :

Levée
Croissance
Maladies et parasites
Récolte
Rentabilité
Santé animale
Maladies animales
Taux de naissances, production de lait, vente d'animaux

PRA Protocol Feb-March 2003

PROGRAMME DE TRAVAIL SUR LE TERRAIN
VILLAGE 1

Profile socio-demographique
- Nombre et composition des quartiers du village
  - Groupe ethniques dans chaque quartier
  - Histoire des relations/conflicts entre les différents groupes ethniques

Cadre institutionel
- extension et niveau d'interaction de l'encadrement avec les producteurs
- intervenants divers (NGO, projet, etc.), y compris expériences passées

Moyens et voies de communication
- Langues
- Présence d'écoles et personnel enseignant, niveau d'alphabetisation
- Eglises, mosquées, et autres lieux de réunion
- Cycle de marché, structures de marché
- Reseaux routiers, moyens de transport publique
- Radio et TV : diffusion dans le village, niveau d'écoute, etc.
- Autres sources d'information

Connaissances locales
- Evaluation de la campagne
  - Evaluation de la campagne précedente
    - Evaluation des dernières 10 années
- Prévisions locales (en géneral)
  - Observations environnementales
  - Specialists religieux (marabouts, charlatans)
- Prévision locales pour la campagne à venir

Contexte écologique
- Types de sols
- Toposéquences dans le village
- Ressources en eau (accés)
  - Eau de surface, nappe fréatique
  - Ecoulement
- Patûrages : ouvert, controlés
- Forêts (classées, sacrée, etc.)

Systèmes de production
- Types de champs
  - Familials, personnels (hommes, femmes)
- Cultures prévalentes
  - Cultures vivrières (cultures, varietés)
  - Cultures secondaires
  - Cultures de rente
  - Cultures de femmes
- Préparation du sol
  - Atélage, tracteurs

- Courbes de niveau, diguettes, etc.
- Gestion de la fertilité du sol
  - Rotation de culture
  - Zai, paillage
  - Application de fumier: fréquence, quantités, comment
  - Engrais (niveau d'utilisation, disponibilité, coût)
- Irrigation
  - Saison humide, sèche
  - Source : puits, mare, barrage
  - Quelles cultures
- Protection des vegétaux
  - Maladie prévalentes, parasites
  - Utilisation de pesticide : disponibilité, source, etc.
- Gestion des cultures
  - Démariage ;
  - Sarclage : combiens de fois, quelle fréquence
  - Autres travaux agricols faire un calendrier des travaux agricols
- Crédit agricole
  - Disponibilité, niveau d'utilisation
  - Sources : projets, banques, commerçants, famille
- Main d'œuvre
  - Main d'œuvre familiale : qui fait quoi
  - Disponibilité de main d'œuvre salariée
  - Invitation de culture, groupes d'entre-aide
- Stockage
  - Durabilité de chaque culture ou varieté utilisée
  - Types de greniers, lieu de stockage pour les différentes cultures

Elevage

- Qui prende des decisions sur la transhumance (ménage, grande famille, village)
- Source d'information utilisé pour decider si et où aller en transhumance
- Accés aux ressources naturelles (patûrage, eau, cure salée)
  - Autour du village (i.e. plans locaux de patûrage)
  - Pendant la transhumance
- Modalités de transhumance (pendant années normales, bonnes, mauvaises)
  - Quels animaux, combien des animaux
  - A quel moment ils partent et pourquoi
  - Pour combien de temps
  - Destinations
  - Phenomènes naturels et sociopolitiques qui jouent un rôle dans la prise de decisions relatives à la transhumance
  - Quelles autres ressources ils cherchent pendant la transhumance (i.e. cure salée)
- Pratiques de gestion de la santé animale
  - Pratiques exigées
  - Facoltative (accessoire), sur quelle base ils decident si utiliser ou non
- Accés aux marché
  - Produit animaux
  - Animaux (viande)
- Main d'oeuvre
  - Si se concentrer sur l'agriculture ou élevage et pourquoi
  - Division de travail au sein de la famille

- Disponibilité et utilisation de la main d'œuvre salariée
- Technologies disponibles
  - Coupage et stockage d'haie (APESS)
  - Tiges
  - Sous-produits agro-industriels)
  - Compostage
  - Parcage
  - Atélage
  - Ambouche
- Santé animale
  - Accès aux soins vetérinaires professionels
  - Autres types de soin non-professionelle (auxilières)
  - Pharmacopée, medicine traditionelle
  - Vaccination
  - Traitements

Stratégies de survie

- Activités rémunératrices
  - Disponible, pratiquées pendant la saison pluvieuse/sèche ou toute l'année
  - Disponible, pratiquées par les hommes, femmes
  - Disponible, pratiquées par les ménages nanti, demuni
- Migrations
  - Saisonnières, longue terme
- Stratégies de survie (sur la base d'une mauvaise année récente : i.e. 2000)
  - Pendants la soudure, année de famines
  - Disponible, pratiquées par les hommes, femmes
  - Disponible, pratiquées par les ménages nanti, demuni
- Gestion des stocks alimentaires
  - Nombre de mois de securité alimentaire
- Prix sur les marchés locaux
  - Cultures vivrières
  - Culture de rente
  - Animaux (taille moyenne)